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ABSTRACT

It is pointed out that there is a desperate need for engineering and computer science doctoral faculty, a need recognized by various schools of science and engineering and by the Federal government. Although the National Science Foundation and other agencies do not see a shortage of college faculty in the other sciences, faculty in some of these colleges of science do indicate that such a shortage will exist at some time in the future. The recognized shortages, and those still unrecognized, stem from the same source: the higher salaries paid to university-trained scientists and engineers at all degree levels by industry. Industry also possesses better research equipment for engineers. Suggestions have been made to have science and engineering schools upgrade themselves, and/or have industry and the Federal government adopt policies that would help these schools accomplish the same purpose. These policies include raising faculty salaries to competitive levels with industry, industry support of faculty workshops, and a tax structure allowing corporations better tax deductions for gifts to universities (including gifts of expensive research equipment). It is suggested that whatever is done must be done quickly since the training of professionals for university faculty positions is a long time affair. (JN)

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ANOTHER EDUCATIONAL PROBLEM:

SHORTAGES OF UNIVERSITY SCIENTIFIC AND ENGINEERING FACULTY

by

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Another Educational Problem:

Shortages of University Scientific and Engineering Faculty

I. Introduction

In the 1983 Presidential State of the Union message, President Reagan outlined his program for this year and called the nation's attention to our many problems. Among these problems he indicated that there is a qualitive need for, "upgrading o math and science instruction" which he would meet "through block gr s to the states." (N.Y. Times) While this paper is not directly concerned with upgrading the instruction of math and science in secondary and elementary schools, it is concerned with the possibility that, as things are now progressing, we may have an acute shortage of Ph.D. personnel for instructing in science and mathematics in our Colleges and Universities. For the purposes of this paper, we will refer to scientific faculty as only those faculty in the "hard" sciences (physical and life) and we will leave out consideration of faculty in the social sciences.

In April 1979 the National Science Foundation published a projection for science and engineering doctorates which indicated a sufficiency of doctorates until 1987. The projections were made first for 5 years from 1977 and then for ten years from 1977, namely for 1982 and 1987 respectively. This pamphlet startled the writer since he had gathered from science and engineering faculty at his university that there would indeed be a future shortage of doctorates in these very disciplines. The future shortage of engineering faculty and perhaps other science faculty was, however, dutifully noted in an October 1980 publication of the National Science Foundation and the Department of Education.

It is not the purpose of this paper to investigate why the first mentioned N.S.F.publication went wrong. However, Table I gives the projections for 1982 and compares them to the actual Doctorates awarded from 1978 until 1982. (NRC Summary Report 1981) These comparisons show a higher projected number of Doctorates by the NSF for all fields that were actually awarded. Indeed Table I shows that the projections underestimated the number of 1978-1982 Doctorates by 10% for life sciences to 38% for Engineers. The reason for this discrepancy may be that the formula used by the NSF for their projections envisioned that a certain number of undergraduate students enrolled in the engineering/science disciplines would go on for Doctorates. This formula in turn was based on what had happened in and before 1977. While the enrollments for the baccalaureate degrees in engineering and science remained high after 1977 evidently fewer of these enrollees then expected did go on for the Ph.D. degree. The NSF does indicate that its projections are limited both by the fact that the assumptions it makes may change and also by the fact that its treatment of broad areas of science i.e. physical sciences may neglect what is actually happening in a specific science i.e. geology (NSF 1979 p. X.i).

(Table I Here)

In spite of the foregoing the question remains, namely, will there be a future shortage of science and engineering academic personnel? If one relies on personal interviews of University faculty and articles written in professional journals, the answer is an overwhelming Yes there will be such a shortage. The importance of recognizing this shortage lies in the fact that a long training cycle is involved for securing the needed number of Scientific/Engineering

Doctoral professionals. This can only come about if we are aware of what is likely to happen and take immediate steps to correct the situation.

The Dean of the School of Engineering and the Head of the Department of Geology of my university in June 1982 both indicated that there would be future shortages of Ph.D. engineers and geologists. In October 1981, D. F. Stein writing in the Journal of Metals said, "It is estimated that between 2,000 and 2,500 engineering faculty positions were vacant in the 1980-1981 academic year." M. E. Van Valkenburg writing in the IEEE Communications magazine in March of 1981 wrote, "The result is that in some engineering graduate schools 70 percent, or even more, of the students are foreign - committed to return to their native lands. From the few Ph.D. graduates willing to consider employment at a university, the many vacancies can scarcely be filled." The American Association of Petroleum Geologists magazine of September 1981 had a succient article by R. H. Holt, Jr. entitled, "How Can We Save the Golden Goose"? In this article he says, "There is yet another dimension of the golden goose syndrome. We are now seeing some of our brightest students turn their backs on the Ph.D. ----- Obviously a shortage of top-flight Ph.D. holders would jeopardize the future quality of faculties." An article appearing in Science in September 1982 by John R. Opel also warned us of Science/Engineering faculty shortages. "And when we move further up the ladder, what do we find? Some 2,000 vacancies in our engineering faculties, with particular glaring weaknesses in computer science, chemical engineering and electrical engineering". The administrators are frightened, the authors of these journal articles are frightened and the NSF does concede that we will have a faculty engineering

problem. It is, therefore, safe to say that a problem does indeed exist for maintaining strong and sufficient faculty for the engineering colleges and perhaps for the other schools of science as well.

It is not hard to find the reasons why fewer students are electing to pursue the Doctoral degree in the Sciences and Engineering. The fault lies chiefly in the market conditions for these disciplines. Scientists and Engineers possessing the Ph.D. degree can make much more money in Industry than can Academics possessing similar degrees. (See Table II). Moreover, in Engineering and Geology people possessing the M.S. degree do almost as well economically as Doctoral holders so the perspective Doctoral candidate is discouraged from going on. I was told, for example, that in the petroleum companies the differential in pay, in 1981, between a M.S. geologist and a Ph.D. geologist was only $5,000/year. In Engineering other factors exacerbate the situation. Industry can hire baccalaurates and pay them better than University T.A.'s and also pay them to study for the M.S. degree at company expense even, in some cases, giving them released time to engage in these studies. Engineering students who once were willing to stay in Universities because of research opportunities now find that such opportunities are better in Industry since Corporate America has the newest and finest research equipment. To sum up, fewer students are engaged in Doctoral degrees in Science/Engineering because of more profitable opportunities in Industry, more opportunities and greater stipends to study for advanced degrees and greater chances to use the most advanced and costly equipment for research. In addition, the students who do go on for Ph.D.'s may be lured from Academia by the higher

salaries paid to them by Industrial Companies.

(Table II about Here)

It is interesting to note that a great number of those people who take Doctoral degrees in U.S. Universities are legal aliens. This is particularly true in Engineering. In 1981 the National Research Council indicated that of all the Engineering Doctorates awarded, 49.1% were awarded to individuals of foreign citizenship. Obviously, many of these will be returning to their native land. However, many of the others who may elect to stay at our Universities may have auditory communication problems that seriously prevent them from reaching their students.

The writers alarmed by the present condition of faculty shortages in the Science/Engineering fields do not stop with merely alerting us to its existence, but are equally concerned with giving us ways of solving this problem. These suggestions involve actions to be taken by the Universities themselves, Industry or the Government. I have, therefore, divided the suggestions into these three headings and will treat each part separately. At least two of the writers suggest a wider use of females in the Science/Engineering areas and while I agree wholeheartedly with this, I fail to see how this would relieve the problem of faculty shortages.

Some of our writers suggest that in order to keep the Engineering/Science standards at a high level, it may be necessary to curtail enrollments or only allow those students into the engineering or computer curricuum who can be adequately taught without straining the existing faculty and laboratory resources. There has been a large growth in class size in most engineering classes and that may well mean that student preparation has become less adequate than it was

before. However, leaving this suggestion aside, all of the other suggestions are concerned with improving the faculty positions so that they can accommodate to this new growth. One suggestion is raising salaries to competitive levels with industry. Three writers suggest changing Schools of Engineering to the Medical or Dental School model. Under this model presumably Engineering Faculty like Medical Faculty could supplement their income by working outside the University setting. My objections to this idea is twofold. First, I doubt whether every Engineering School is located in a place that has easy access to the major research and development departments of large corporations, and second I feel that undergraduate engineering students probably need more closer faculty student relationships than do graduate students in medicene who indeed do receive this kind of relationship in their internship.

Industry is asked by our writers to substantially increase their spending for Universities. One writer (Stein) indicates that at this time less than 2% of the total Education budget is from Corporate America. The additional funding would be spent for increased graduate stipends, to sponsor University research, for better University research equipment and for summer grants for projects of faculty research involving graduate students. Other suggestions that are somewhat original would have Corporations sponsor workshops for faculty, and pay their way to research conferences so that they could keep up with the state of the Art.

It is suggested that the Federal Government could help by a more innovative tax structure that would allow Corporations better tax deductions for gifts to Universities including gifts of expensive research equipment. There should be more sharing of research and of

laboratory equipment between Industry and the Universities. The government could bring this about by a review of current patent and copyright laws. Further, the government should fund needed research equipment through its method of grants to Universities. One way that new faculty might be recruited is by setting up Government scholarships for Ph.D., Engineering and Computer Science students and follow that up with three year research grants for new University Ph.D. faculty. Other government funding could be allocated for joint projects of Industry and Universities that provide money to upgrade faculty salaries and research. Combined Departments of the government could offer research grants for investigations they desire and Universities could bid for these projects.

In conclusion then, there is a desperate need for Engineering and Computer Science Doctoral faculty. This need is recognized by the various schools of Science and Engineering and by the Federal Government. Although the NSF and other agencies do not see a shortage of College faculty in the other sciences the faculty in some of these Colleges of Science do indicate such a shortage will exist at some time in the near future. The recognized shortages and those still unrecognized stem from the same source; the higher salaries paid to University trained Scientists/Engineers at all degree levels by industry. Industry also possesses better research equipment for Engineers. Suggestions have been made to have the Schools of Science/Engineering upgrade themselves, and/or have Industry and the Federal Government adopt policies that would help them accomplish the same purpose. Whatever is done must be done quickly since the training of professionals for University faculty positions is a long time affair. Action taken in 1983 may not be effective until 1986 or

later. Only those who carefully prepare for the future are entitled to enjoy it.

Table I

A Comparison of Actual and Estimated Science
And Engineering Full Time Doctoral Entrants
1978 through 1982

	Projected*	Actual**	Difference	%
Physical Sciences (Includes Mathematics and Computer Sciences)	27,000	20,964	-6,036	-11%
Engineering	20,000	12,400	-7,600	-38%
Life Sciences	29,000	25,973	-3,027	10%

*Projections of Science and Engineering Doctorate Supply and Utilization 1982-1987; National Science Foundation, Washington, D.C.: U.S. Government Printing Office, 1979 p.5

**1978 through 1981 figures; Summary Report 1981 Doctorate Recipients From United States Universities; National Research Council, Washington, D.C. p.4 ,1982 figures are the mean of 1978 thru 1981 numbers.

Table II

1979 Median Salary Differentials of Engineers
and Scientists Working in Education,
Business and the Federal Government

Disciplines	Educational Institutions	Business and Industry	Federal Government
Physical Sciences	26,500	33,100	33,200
Math. Sciences	25,500	30,800	36,300
Computer Specialists	25,400	29,600	None
Environmental Scientists	26,700	34,000	35,300
Life Scientists	26,400	33,300	32,000
Engineers	30,000	35,000	35,200

Taken From Characteristics of Doctoral
Scientists and Engineers in the United States:1979
(N.S.F. 80-323),Table B-15 p. 46.

Bibliography

Part I. Authored Articles

Dott, R.H. Jr., September 1981
"How Can We Save the Golden Goose?", American Association of Petroleum Geologists Explorer, Vol. 3, No. 1 pp. 22-23.

Opel, John R., September 17, 1982
"Education, Science, and National Economic Competitiveness," Science, Vol. 217, No. 4565.

Stein, D. F. October 1981
"Impending Engineering Shortage: Consequences for Education and Industry", Journal of Metals, Vol. 33, No. 10 pp. 38-41.

Van Valkenberg, M. E. March 1981
"Trends in Engineering Education," I.E.E.E. Communications Magazine, Vol. 19, No. 2, pp. 20-22.

Part II. Official Reports

Characteristics of Doctoral Scientists and Engineers in the United States: 1979, National Science Foundation, Washington, D. C.

Projections of Science and Engineering Doctorate Supply and Utilization 1982 and 1987, National Science Foundation, Washington, D.C.: U.S. Government Printing Office, 1979.

Science and Engineering Education for the 1980's and Beyond, National Science Foundation and the Department of Education, Washington, D.C.: U.S. Government Printing Office, October 1980.

"State of the Union Message," New York Times, New York, N.Y.: January 26, 1983 p. A 14.

Summary Report 1981 Doctorate Recipients from United States Universities, National Research Council, Washington, D.C.: National Academy Press, 1982.